

# CERTIFICATE

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# Standard Method of CORE SAMPLING OF RAW WOOL IN PACKAGES FOR DETERMINATION OF PERCENTAGE OF CLEAN WOOL FIBER PRESENT<sup>1</sup>

This Standard is issued under the fixed designation D 1060; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval.

## 1. Scope

1.1 This method of sampling covers a procedure for obtaining samples from lots of wool or related fibers in bales or bags for the determination of the clean fiber content by a procedure similar to those described in Methods D 584.

1.2 The method provides a description of suitable core sampling equipment, the sampling procedure, and the method for determining the number of packages to be bored and the number of cores to be taken from each sampled package.

1.3 Reliable estimates are given for the standard deviation of the percentage clean wool content between packages and within packages for lots of many types of raw wool.

## 2. Applicable Documents

### 2.1 ASTM Standards:

D 123 Definitions of Terms Relating to Textile Materials<sup>2</sup>

D 584 Tests for Wool Content of Raw Wool-Laboratory<sup>2</sup>

E 122 Recommended Practice for Choice of Sample Size to Estimate the Average Quality of a Lot or Process<sup>3</sup>

## 3. Definitions

3.1 *core (core sampling)*—the portion of wool or other fiber obtained from a package by use of the sampling tube described in 6.1.

3.2 For definitions of other terms used in this method, refer to Definitions D 123.

## 4. Summary of Method

4.1 The lot is core sampled in accordance with one of a series of equivalent schedules based on estimates of variability of the percentage clean wool content and on the desired level of precision. Guidance in the selection of the most economical of the equivalent schedules is provided.

## 5. Uses and Significance

5.1 Core sampling is widely accepted, when applicable, for obtaining a laboratory sample representative of the clean wool content of a lot of packaged raw wool.

5.2 If the wool is so loosely packed that a core cannot be cut, or if it is so highly compressed that the sampling tool cannot readily penetrate into the package to the desired depth and in the desired direction, core sampling is not applicable. The density of wool in most types of commercial packages is suitable for sampling by this method.

5.3 The procedure described in this method is adapted to the application of statistical methods for estimating the size of sample required to achieve a desired level of sample

<sup>1</sup> This method is under the jurisdiction of ASTM Committee D-13 on Textiles and is the direct responsibility of Subcommittee D13.13 on Wool Fibers.

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<sup>2</sup> 1974 Annual Book of ASTM Standards, Part 33.

<sup>3</sup> 1974 Annual Book of ASTM Standards, Parts 15 and 41.

precision at minimum cost.

NOTE—The basic sampling equipment, operating procedure, and statistical approach used in this method have been adapted for sampling lots of wool for the determination of other properties that are not affected by boring, such as average fiber diameter, and for sampling lots of other bulk fibers in packages.

## 6. Apparatus

6.1 *Sampling Tool*—A tube equipped with a cutting edge, together with a drill, hammer, press, or similar device, and accessories. The tube must be capable of penetrating the required distance (see 7.2) into a package of wool and cutting a core therefrom, which core must be retained substantially unchanged within the tube during its withdrawal from a package.

6.1.1 Figure 1 illustrates the design of a recommended type of rotatable small-diameter wool sampling tube.

6.1.2 Sampling tubes in common use range from approximately  $\frac{1}{2}$  to 2 in. (10 to 50 mm) in diameter, and from 10 to 40 in. (250 to 1000 mm) in length.

6.1.3 Some types of sampling tubes are equipped with receptacles at the rear of the tube.

6.1.4 Drills of  $\frac{1}{2}$  hp, rotating at 200 to 550 rpm, have been found to be satisfactory.

6.1.5 A toothed cutting edge on a rotating tube of small diameter, instead of the smooth edge illustrated in Fig. 1, is acceptable provided that for any specific design it has been shown that a bias is not introduced thereby. The absence of bias in samples obtained with a rotating 2-in. diameter tube with toothed cutting edge has been demonstrated.

6.2 *Sample Container*—A container with closure of such material and so constructed that a sample stored therein will not show a material change in its moisture content during the interval between sampling and weighing the sample for test.

## 7. Sampling Procedure

7.1 *Time of Sampling*—Take the sample at or about the time the lot is weighed.

7.2 *Depth of Penetration*—Penetrate a bale of wool with the sampling tube to a depth such that substantially all parts of the package can be reached. Maintain the same depth of penetration for each core taken from

a given lot.

### 7.3 Location of Borings:

7.3.1 Consider a package as composed of eight sections approximately equal in volume, defined by top or bottom, front or back, left or right.

7.3.2 Alternate the location of boring in such a fashion that the total composite sample will consist of approximately the same number of cores from each section of the packages.

7.3.3 If the packages have been compressed in a baling press, enter a package through a compression surface and in a direction normal to that surface.

7.4 Whenever there is danger that loose sand or other material may drop out of the tube during or after boring, so position the package that the direction of boring will be horizontal.

7.5 Before entering a sampling tube into a package of wool, cut the burlap covering in such a way that none of the burlap fibers become mixed with the core or with the wool in the package.

7.6 Immediately upon withdrawal of the tube after boring, extrude the core directly into the sample container or the intermediate receptacle without loss of material or unnecessary exposure to atmospheric conditions that may result in a change in the moisture content of the core.

## 8. Size of Sample<sup>4</sup>

8.1 *Precision*—Unless otherwise agreed upon, base the size of the sample upon a sampling precision of  $\pm 1.0$  percent clean wool content, at a probability level of 0.95.

8.2 *Nature of Sample Size Specification*—The specification for the size of the sample consists of the number of packages to be selected at random from the lot and the uniform number of cores to be taken from each selected package.

8.3 *Number of Packages*—Calculate the minimum number of packages to be selected at random from the lot by Eq 1:

<sup>4</sup>For background information, see the paper by Louis Tanner and W. Edwards Deming, "Some Problems in the Sampling of Bulk Materials," *Proceedings, Am. Soc. Testing Mats*, Vol 49, 1949, p. 1181 and ASTM Recommended Practice E 105, for Probability Sampling of Materials, see 1974 *Annual Book of ASTM Standards*, Part 32.

$$n = N(\sigma_w^2 + k\sigma_b^2)/kN(E/t)^2 + k\sigma_b^2 \quad (1)$$

where:

- $n$  = number of packages to be selected for coring,
- $N$  = number of packages in the lot,
- $k$  = number of cores to be taken from each selected package,
- $E$  = desired sample precision, in percentage clean wool content,
- $t$  = probability factor,<sup>5</sup>
- $\sigma_w^2$  = variance<sup>4</sup> (of the percentage clean wool content) of individual cores within packages in the lot, and
- $\sigma_b^2$  = variance<sup>5</sup> (of the percentage clean wool content) of the packages in the lot.

**8.4 Number of Cores Per Package**—The number of cores,  $k$ , to be taken from each selected package is optional. However, for any given set of conditions one value of  $k$  is most economical. If desired, calculate this value,  $k_e$ , by Eq 2:

$$k_e = \sqrt{\sigma_w^2 C_1 / \sigma_b^2 C_2} \quad (2)$$

where:

- $k_e$  = number of cores per selected package that will result in the most economical sample of the desired precision,
- $C_1$  = average cost of selecting a bale and positioning it for coring, and
- $C_2$  = average cost of taking and handling a core.

Round off the calculated value of  $k_e$  to the nearest whole number.

## 8.5 Estimates of the Variances:

**8.5.1** The true values of  $\sigma_w^2$  and  $\sigma_b^2$  for any given lot of wool will in general not be known. Use reliable estimates of the variances based on previous experience with similar lots of wool, or obtained by a preliminary test, or obtained from the Appendix.

**8.5.2** In Appendix A1 are listed for observed average values of  $\sigma_b$  and  $\sigma_w$  for lots of several types of wool as they appeared in the commerce of the United States early in 1964.

**8.5.3** For methods of estimating approximate variances from general knowledge about a lot of material, see Recommended Practice E 122.

**8.5.4** When no reliable estimates are available, use the conservative value of 5.0 for both  $\sigma_b$  and  $\sigma_w$  in Eq 1 when the sampling of lots of wool for the determination of percentage clean wool content is performed in accordance with this method.

## 9. Sampling Schedules

**9.1** For convenience, Table 1 gives the values of  $n$  calculated by Eq 1 for selected pairs of values of  $\sigma_w$  and  $\sigma_b$  and for selected lot sizes,  $N$ , and numbers of cores per package,  $k$ , for a sampling precision of  $\pm 1.0$  per cent clean wool content at a probability level of 95 percent.

<sup>5</sup> See "ASTM Manual on Quality Control of Materials," Am. Soc. Testing Mats. (Issued as a separate publication, *STP 15 C*.)

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TABLE 1 Values of  $n$  Calculated from Eq 1 for a Precision of  $\pm 1.0$  Percent Wool Content at a Probability Level of 95 Percent<sup>a</sup>, for Selected Values of  $\sigma_w$ ,  $\sigma_b$ , and  $k$

| $\sigma_w$ | $\sigma_b$ | Number of Cores<br>per Sampled<br>Package, $k$ | Number of Packages in Lot, $N$        |    |    |     |     |     |     |     |     |      |
|------------|------------|------------------------------------------------|---------------------------------------|----|----|-----|-----|-----|-----|-----|-----|------|
|            |            |                                                | 25                                    | 50 | 75 | 100 | 150 | 200 | 300 | 500 | 750 | 1000 |
|            |            |                                                | Number of Packages to be Sampled, $n$ |    |    |     |     |     |     |     |     |      |
| 1.0        | 1.0        | 1                                              | 7                                     | 8  | 8  | 8   | 8   | 8   | 8   | 8   | 8   | 8    |
| 1.0        | 1.5        | 1                                              | 10                                    | 11 | 12 | 12  | 12  | 12  | 13  | 13  | 13  | 13   |
| 1.0        | 2.0        | 1                                              | 12                                    | 15 | 17 | 17  | 18  | 18  | 19  | 19  | 19  | 19   |
| 1.0        | 2.5        | 1                                              | 15                                    | 19 | 22 | 23  | 24  | 25  | 26  | 27  | 27  | 28   |
| 1.0        | 3.0        | 1                                              | 17                                    | 23 | 27 | 29  | 32  | 33  | 35  | 36  | 37  | 38   |
| 1.0        | 3.5        | 1                                              | 18                                    | 27 | 32 | 35  | 39  | 43  | 44  | 47  | 48  | 49   |
| 1.0        | 4.0        | 1                                              | 19                                    | 30 | 36 | 41  | 47  | 50  | 55  | 59  | 61  | 62   |
| 1.0        | 4.5        | 1                                              | 20                                    | 32 | 40 | 46  | 54  | 59  | 65  | 71  | 74  | 76   |
| 1.0        | 5.0        | 1                                              | 21                                    | 35 | 44 | 51  | 61  | 68  | 76  | 84  | 89  | 92   |
| 1.5        | 1.0        | 1                                              | 11                                    | 12 | 12 | 13  | 13  | 13  | 13  | 13  | 13  | 13   |
| 1.5        | 1.5        | 1                                              | 13                                    | 15 | 16 | 16  | 17  | 17  | 17  | 17  | 18  | 18   |
| 1.5        | 2.0        | 1                                              | 15                                    | 19 | 20 | 21  | 22  | 23  | 23  | 24  | 24  | 24   |
| 1.5        | 2.5        | 1                                              | 17                                    | 23 | 25 | 27  | 29  | 30  | 31  | 32  | 32  | 32   |
| 1.5        | 3.0        | 1                                              | 19                                    | 26 | 30 | 33  | 36  | 37  | 39  | 41  | 42  | 42   |
| 1.5        | 3.5        | 1                                              | 20                                    | 29 | 35 | 38  | 43  | 46  | 49  | 51  | 53  | 54   |
| 1.5        | 4.0        | 1                                              | 21                                    | 32 | 39 | 44  | 50  | 54  | 59  | 63  | 65  | 67   |
| 1.5        | 4.5        | 1                                              | 21                                    | 34 | 43 | 49  | 57  | 63  | 69  | 75  | 79  | 81   |
| 1.5        | 5.0        | 1                                              | 22                                    | 36 | 46 | 54  | 64  | 71  | 80  | 88  | 93  | 96   |
| 2.0        | 1.0        | 1                                              | 17                                    | 18 | 19 | 19  | 19  | 19  | 19  | 20  | 20  | 20   |
| 2.0        | 1.5        | 2                                              | 10                                    | 11 | 11 | 12  | 12  | 12  | 12  | 12  | 12  | 12   |
|            |            | 1                                              | 18                                    | 21 | 22 | 23  | 23  | 24  | 24  | 24  | 24  | 24   |
| 2.0        | 2.0        | 2                                              | 13                                    | 14 | 15 | 16  | 16  | 16  | 16  | 17  | 17  | 17   |
|            |            | 1                                              | 20                                    | 24 | 26 | 27  | 28  | 29  | 30  | 30  | 31  | 31   |
| 2.0        | 2.5        | 2                                              | 15                                    | 18 | 20 | 20  | 21  | 22  | 22  | 23  | 23  | 23   |
|            |            | 1                                              | 21                                    | 27 | 30 | 32  | 34  | 36  | 37  | 38  | 39  | 39   |
| 2.0        | 3.0        | 2                                              | 17                                    | 22 | 25 | 26  | 28  | 29  | 30  | 31  | 31  | 31   |
|            |            | 1                                              | 21                                    | 30 | 35 | 38  | 41  | 43  | 45  | 47  | 48  | 49   |
| 2.0        | 3.5        | 2                                              | 18                                    | 25 | 29 | 32  | 35  | 37  | 38  | 40  | 41  | 41   |
|            |            | 1                                              | 22                                    | 33 | 39 | 43  | 48  | 51  | 54  | 58  | 59  | 60   |
| 2.0        | 4.0        | 2                                              | 19                                    | 29 | 34 | 38  | 42  | 45  | 48  | 51  | 52  | 53   |
|            |            | 1                                              | 23                                    | 35 | 43 | 48  | 55  | 59  | 64  | 69  | 72  | 73   |
| 2.0        | 4.5        | 2                                              | 20                                    | 32 | 39 | 43  | 50  | 53  | 58  | 62  | 64  | 66   |
|            |            | 1                                              | 23                                    | 37 | 46 | 53  | 62  | 68  | 74  | 81  | 85  | 87   |
| 2.0        | 5.0        | 2                                              | 21                                    | 34 | 42 | 49  | 57  | 62  | 68  | 74  | 78  | 80   |
|            |            | 1                                              | 24                                    | 39 | 49 | 57  | 68  | 76  | 85  | 94  | 99  | 102  |
|            |            | 2                                              | 22                                    | 36 | 46 | 53  | 64  | 71  | 79  | 88  | 92  | 95   |
| 2.5        | 1.0        | 1                                              | 25                                    | 26 | 27 | 27  | 28  | 28  | 28  | 28  | 28  | 28   |
| 2.5        | 1.5        | 2                                              | 14                                    | 15 | 16 | 16  | 16  | 16  | 16  | 16  | 16  | 16   |
|            |            | 1                                              | 25                                    | 28 | 30 | 31  | 31  | 32  | 32  | 33  | 33  | 33   |
| 2.5        | 2.0        | 2                                              | 16                                    | 18 | 19 | 20  | 20  | 20  | 21  | 21  | 21  | 21   |
|            |            | 1                                              | 25                                    | 31 | 33 | 35  | 36  | 37  | 38  | 39  | 39  | 39   |
| 2.5        | 2.5        | 2                                              | 17                                    | 21 | 23 | 24  | 25  | 26  | 27  | 27  | 27  | 27   |
|            |            | 1                                              | 25                                    | 33 | 37 | 39  | 42  | 43  | 45  | 46  | 47  | 47   |
| 2.5        | 3.0        | 2                                              | 19                                    | 25 | 28 | 30  | 32  | 33  | 34  | 35  | 35  | 36   |
|            |            | 1                                              | 25                                    | 35 | 41 | 44  | 48  | 50  | 53  | 55  | 57  | 57   |
| 2.5        | 3.5        | 2                                              | 20                                    | 28 | 32 | 35  | 38  | 40  | 42  | 44  | 45  | 46   |
|            |            | 1                                              | 25                                    | 37 | 44 | 49  | 55  | 58  | 62  | 65  | 67  | 68   |
| 2.5        | 4.0        | 2                                              | 21                                    | 31 | 37 | 41  | 45  | 48  | 52  | 54  | 56  | 57   |
|            |            | 1                                              | 25                                    | 39 | 47 | 53  | 61  | 66  | 71  | 77  | 80  | 81   |
| 2.5        | 4.5        | 2                                              | 22                                    | 33 | 41 | 46  | 53  | 57  | 61  | 66  | 68  | 70   |
|            |            | 1                                              | 25                                    | 40 | 50 | 58  | 67  | 74  | 81  | 89  | 93  | 95   |
| 2.5        | 5.0        | 2                                              | 22                                    | 36 | 45 | 51  | 60  | 65  | 72  | 78  | 82  | 84   |
|            |            | 1                                              | 25                                    | 42 | 53 | 62  | 74  | 82  | 91  | 101 | 107 | 110  |
|            |            | 2                                              | 23                                    | 37 | 48 | 56  | 66  | 73  | 82  | 90  | 96  | 99   |

TABLE 1 Continued

| $\sigma_w$ | $\sigma_c$ | Number of Cores<br>per Sampled<br>Package, $k$ | Number of Packages in Lot, $N$        |    |    |     |     |     |     |     |     |      |
|------------|------------|------------------------------------------------|---------------------------------------|----|----|-----|-----|-----|-----|-----|-----|------|
|            |            |                                                | 25                                    | 50 | 75 | 100 | 150 | 200 | 300 | 500 | 750 | 1000 |
|            |            |                                                | Number of Packages to be Sampled, $n$ |    |    |     |     |     |     |     |     |      |
| 3.0        | 1.0        | 1                                              | <sup>b</sup>                          | 36 | 37 | 37  | 38  | 38  | 38  | 39  | 39  | 39   |
|            |            | 2                                              | 19                                    | 20 | 21 | 21  | 21  | 21  | 21  | 21  | 22  | 22   |
| 3.0        | 1.5        | 1                                              | <sup>b</sup>                          | 37 | 39 | 40  | 41  | 42  | 43  | 43  | 43  | 43   |
|            |            | 2                                              | 20                                    | 23 | 24 | 24  | 25  | 25  | 26  | 26  | 26  | 26   |
| 3.0        | 2.0        | 1                                              | <sup>b</sup>                          | 39 | 42 | 44  | 46  | 47  | 48  | 49  | 49  | 50   |
|            |            | 2                                              | 21                                    | 25 | 28 | 29  | 30  | 31  | 32  | 32  | 32  | 33   |
| 3.0        | 2.5        | 1                                              | <sup>b</sup>                          | 40 | 45 | 48  | 51  | 53  | 55  | 56  | 57  | 58   |
|            |            | 2                                              | 22                                    | 28 | 32 | 34  | 36  | 37  | 39  | 40  | 41  | 41   |
| 3.0        | 3.0        | 1                                              | <sup>b</sup>                          | 41 | 48 | 52  | 57  | 59  | 63  | 65  | 67  | 67   |
|            |            | 2                                              | 22                                    | 31 | 36 | 39  | 43  | 45  | 47  | 49  | 50  | 51   |
| 3.0        | 3.5        | 1                                              | <sup>b</sup>                          | 43 | 51 | 56  | 63  | 67  | 71  | 75  | 77  | 78   |
|            |            | 2                                              | 23                                    | 34 | 40 | 44  | 49  | 53  | 56  | 59  | 61  | 62   |
| 3.0        | 4.0        | 1                                              | <sup>b</sup>                          | 44 | 53 | 60  | 69  | 74  | 80  | 86  | 89  | 91   |
|            |            | 2                                              | 23                                    | 36 | 44 | 49  | 56  | 61  | 66  | 71  | 73  | 75   |
| 3.0        | 4.5        | 1                                              | <sup>b</sup>                          | 44 | 56 | 64  | 74  | 81  | 90  | 98  | 102 | 105  |
|            |            | 2                                              | 24                                    | 38 | 47 | 54  | 63  | 69  | 76  | 83  | 87  | 89   |
| 3.0        | 5.0        | 1                                              | <sup>b</sup>                          | 45 | 58 | 67  | 80  | 89  | 99  | 110 | 116 | 120  |
|            |            | 2                                              | 24                                    | 39 | 50 | 58  | 70  | 77  | 86  | 96  | 101 | 104  |
| 3.5        | 1.0        | 1                                              | <sup>b</sup>                          | 48 | 49 | 50  | 50  | 50  | 51  | 51  | 51  | 51   |
|            |            | 2                                              | 24                                    | 26 | 27 | 27  | 27  | 27  | 28  | 28  | 28  | 28   |
|            |            | 3                                              | 17                                    | 19 | 19 | 19  | 20  | 20  | 20  | 20  | 20  | 20   |
|            |            | 4                                              | 14                                    | 15 | 15 | 16  | 16  | 16  | 16  | 16  | 16  | 16   |
| 3.5        | 1.5        | 1                                              | <sup>b</sup>                          | 48 | 50 | 52  | 53  | 54  | 55  | 55  | 56  | 56   |
|            |            | 2                                              | 24                                    | 28 | 29 | 30  | 31  | 31  | 32  | 32  | 32  | 32   |
|            |            | 3                                              | 19                                    | 21 | 22 | 23  | 24  | 24  | 24  | 24  | 25  | 25   |
|            |            | 4                                              | 16                                    | 18 | 19 | 19  | 20  | 20  | 20  | 21  | 21  | 21   |
| 3.5        | 2.0        | 1                                              | <sup>b</sup>                          | 48 | 52 | 55  | 57  | 58  | 60  | 61  | 62  | 62   |
|            |            | 2                                              | 25                                    | 30 | 33 | 34  | 36  | 37  | 38  | 38  | 39  | 39   |
|            |            | 3                                              | 20                                    | 24 | 26 | 27  | 29  | 29  | 30  | 31  | 31  | 31   |
|            |            | 4                                              | 17                                    | 21 | 23 | 24  | 25  | 26  | 26  | 27  | 27  | 27   |
| 3.5        | 2.5        | 1                                              | <sup>b</sup>                          | 49 | 54 | 58  | 62  | 64  | 66  | 68  | 69  | 70   |
|            |            | 2                                              | 25                                    | 33 | 37 | 39  | 41  | 43  | 45  | 46  | 47  | 47   |
|            |            | 3                                              | 21                                    | 27 | 31 | 33  | 35  | 36  | 37  | 38  | 39  | 39   |
|            |            | 4                                              | 19                                    | 25 | 28 | 29  | 31  | 32  | 34  | 35  | 35  | 35   |
| 3.5        | 3.0        | 1                                              | <sup>b</sup>                          | 49 | 56 | 61  | 67  | 70  | 74  | 77  | 79  | 79   |
|            |            | 2                                              | 25                                    | 35 | 40 | 44  | 48  | 50  | 53  | 55  | 56  | 57   |
|            |            | 3                                              | 22                                    | 30 | 35 | 38  | 41  | 43  | 46  | 48  | 49  | 49   |
|            |            | 4                                              | 20                                    | 28 | 32 | 35  | 38  | 40  | 42  | 44  | 45  | 45   |
| 3.5        | 3.5        | 1                                              | <sup>b</sup>                          | 49 | 58 | 65  | 72  | 77  | 82  | 87  | 89  | 90   |
|            |            | 2                                              | 25                                    | 37 | 44 | 49  | 54  | 58  | 62  | 65  | 67  | 68   |
|            |            | 3                                              | 22                                    | 33 | 39 | 43  | 48  | 51  | 55  | 58  | 60  | 60   |
|            |            | 4                                              | 21                                    | 31 | 37 | 41  | 45  | 48  | 51  | 54  | 56  | 57   |
| 3.5        | 4.0        | 1                                              | <sup>b</sup>                          | 49 | 60 | 68  | 77  | 84  | 91  | 97  | 101 | 103  |
|            |            | 2                                              | 25                                    | 39 | 47 | 53  | 61  | 66  | 71  | 76  | 79  | 81   |
|            |            | 3                                              | 23                                    | 35 | 43 | 48  | 55  | 60  | 65  | 69  | 72  | 73   |
|            |            | 4                                              | 22                                    | 33 | 41 | 46  | 52  | 57  | 61  | 66  | 68  | 69   |
| 3.5        | 4.5        | 1                                              | <sup>b</sup>                          | 49 | 62 | 71  | 83  | 90  | 100 | 109 | 114 | 116  |
|            |            | 2                                              | 25                                    | 40 | 50 | 57  | 67  | 73  | 81  | 88  | 92  | 95   |
|            |            | 3                                              | 23                                    | 37 | 46 | 53  | 62  | 68  | 75  | 81  | 85  | 87   |
|            |            | 4                                              | 22                                    | 36 | 44 | 51  | 59  | 65  | 72  | 78  | 82  | 84   |
| 3.5        | 5.0        | 1                                              | <sup>b</sup>                          | 49 | 63 | 73  | 88  | 97  | 109 | 121 | 127 | 131  |
|            |            | 2                                              | 25                                    | 41 | 53 | 61  | 73  | 81  | 91  | 101 | 106 | 110  |
|            |            | 3                                              | 24                                    | 39 | 49 | 57  | 69  | 76  | 85  | 94  | 100 | 102  |
|            |            | 4                                              | 23                                    | 37 | 48 | 55  | 66  | 73  | 82  | 91  | 96  | 99   |

TABLE 1 Continued

| $\sigma_w$ | $\sigma_c$ | Number of Cores<br>per Sampled<br>Package, $k$ | Number of Packages in Lot, $N$        |     |     |     |     |     |     |     |     |      |
|------------|------------|------------------------------------------------|---------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
|            |            |                                                | 25                                    | 50  | 75  | 100 | 150 | 200 | 300 | 500 | 750 | 1000 |
|            |            |                                                | Number of Packages to be Sampled, $n$ |     |     |     |     |     |     |     |     |      |
| 4.0        | 1.0        | 1                                              | $b$                                   | $b$ | 63  | 63  | 64  | 65  | 65  | 65  | 65  | 66   |
|            |            | 2                                              | $b$                                   | 33  | 33  | 34  | 34  | 34  | 35  | 35  | 35  | 35   |
|            |            | 3                                              | 22                                    | 23  | 24  | 24  | 24  | 24  | 25  | 25  | 25  | 25   |
|            |            | 4                                              | 17                                    | 18  | 19  | 19  | 19  | 19  | 19  | 20  | 20  | 20   |
| 4.0        | 1.5        | 1                                              | $b$                                   | $b$ | 63  | 65  | 67  | 68  | 69  | 69  | 70  | 70   |
|            |            | 2                                              | $b$                                   | 34  | 36  | 37  | 38  | 38  | 39  | 39  | 39  | 40   |
|            |            | 3                                              | 22                                    | 25  | 27  | 27  | 28  | 28  | 29  | 29  | 29  | 29   |
|            |            | 4                                              | 18                                    | 21  | 22  | 23  | 24  | 24  | 24  | 24  | 24  | 24   |
| 4.0        | 2.0        | 1                                              | $b$                                   | $b$ | 64  | 67  | 70  | 72  | 74  | 75  | 76  | 76   |
|            |            | 2                                              | $b$                                   | 36  | 39  | 40  | 42  | 43  | 44  | 45  | 46  | 46   |
|            |            | 3                                              | 23                                    | 28  | 30  | 32  | 33  | 34  | 35  | 35  | 36  | 36   |
|            |            | 4                                              | 20                                    | 24  | 26  | 27  | 28  | 29  | 30  | 30  | 31  | 31   |
| 4.0        | 2.5        | 1                                              | $b$                                   | $b$ | 65  | 69  | 74  | 77  | 80  | 82  | 83  | 84   |
|            |            | 2                                              | $b$                                   | 37  | 42  | 45  | 48  | 49  | 51  | 53  | 54  | 54   |
|            |            | 3                                              | 23                                    | 31  | 34  | 36  | 39  | 40  | 42  | 43  | 44  | 44   |
|            |            | 4                                              | 21                                    | 27  | 30  | 32  | 34  | 36  | 37  | 38  | 39  | 39   |
| 4.0        | 3.0        | 1                                              | $b$                                   | $b$ | 66  | 72  | 79  | 82  | 87  | 90  | 92  | 93   |
|            |            | 2                                              | $b$                                   | 39  | 45  | 49  | 54  | 56  | 59  | 62  | 63  | 64   |
|            |            | 3                                              | 24                                    | 33  | 38  | 41  | 45  | 47  | 50  | 52  | 53  | 54   |
|            |            | 4                                              | 21                                    | 30  | 35  | 38  | 41  | 43  | 45  | 47  | 48  | 49   |
| 4.0        | 3.5        | 1                                              | $b$                                   | $b$ | 67  | 74  | 83  | 88  | 94  | 100 | 103 | 104  |
|            |            | 2                                              | $b$                                   | 41  | 48  | 53  | 60  | 63  | 68  | 72  | 74  | 75   |
|            |            | 3                                              | 24                                    | 35  | 42  | 46  | 52  | 55  | 59  | 62  | 64  | 65   |
|            |            | 4                                              | 22                                    | 33  | 39  | 43  | 48  | 51  | 54  | 58  | 59  | 60   |
| 4.0        | 4.0        | 1                                              | $b$                                   | $b$ | 68  | 77  | 88  | 95  | 103 | 110 | 114 | 116  |
|            |            | 2                                              | $b$                                   | 42  | 51  | 58  | 66  | 71  | 77  | 83  | 86  | 87   |
|            |            | 3                                              | 24                                    | 37  | 46  | 61  | 69  | 63  | 69  | 73  | 76  | 78   |
|            |            | 4                                              | 23                                    | 35  | 43  | 48  | 55  | 59  | 64  | 69  | 72  | 73   |
| 4.0        | 4.5        | 1                                              | $b$                                   | $b$ | 69  | 79  | 92  | 101 | 111 | 121 | 127 | 130  |
|            |            | 2                                              | $b$                                   | 43  | 54  | 62  | 72  | 79  | 87  | 94  | 99  | 101  |
|            |            | 3                                              | 24                                    | 39  | 49  | 56  | 65  | 71  | 79  | 86  | 90  | 92   |
|            |            | 4                                              | 23                                    | 37  | 46  | 53  | 62  | 68  | 74  | 81  | 85  | 87   |
| 4.0        | 5.0        | 1                                              | $b$                                   | $b$ | 70  | 81  | 97  | 107 | 120 | 133 | 140 | 144  |
|            |            | 2                                              | $b$                                   | 44  | 56  | 65  | 78  | 86  | 97  | 107 | 113 | 116  |
|            |            | 3                                              | 25                                    | 40  | 52  | 60  | 72  | 79  | 89  | 98  | 104 | 107  |
|            |            | 4                                              | 24                                    | 39  | 49  | 57  | 68  | 76  | 85  | 94  | 99  | 102  |
| 4.5        | 1.0        | 1                                              | $b$                                   | $b$ | $b$ | 79  | 80  | 81  | 81  | 82  | 82  | 82   |
|            |            | 2                                              | $b$                                   | 40  | 41  | 42  | 42  | 42  | 43  | 43  | 43  | 43   |
|            |            | 3                                              | $b$                                   | 28  | 29  | 29  | 30  | 30  | 30  | 30  | 30  | 30   |
|            |            | 4                                              | 21                                    | 22  | 23  | 23  | 23  | 23  | 23  | 24  | 24  | 24   |
| 4.5        | 1.5        | 1                                              | $b$                                   | $b$ | $b$ | 80  | 82  | 83  | 85  | 85  | 86  | 86   |
|            |            | 2                                              | $b$                                   | 41  | 43  | 44  | 45  | 46  | 47  | 47  | 47  | 48   |
|            |            | 3                                              | $b$                                   | 30  | 32  | 32  | 33  | 34  | 34  | 34  | 35  | 35   |
|            |            | 4                                              | 21                                    | 24  | 26  | 26  | 27  | 27  | 28  | 28  | 28  | 28   |
| 4.5        | 2.0        | 1                                              | $b$                                   | $b$ | $b$ | 81  | 85  | 87  | 89  | 91  | 92  | 92   |
|            |            | 2                                              | $b$                                   | 42  | 46  | 48  | 50  | 51  | 52  | 53  | 54  | 54   |
|            |            | 3                                              | $b$                                   | 32  | 35  | 36  | 38  | 39  | 40  | 41  | 41  | 41   |
|            |            | 4                                              | 22                                    | 27  | 29  | 31  | 32  | 33  | 34  | 34  | 35  | 35   |
| 4.5        | 2.5        | 1                                              | $b$                                   | $b$ | $b$ | 83  | 88  | 91  | 95  | 98  | 99  | 100  |
|            |            | 2                                              | $b$                                   | 43  | 48  | 51  | 55  | 57  | 59  | 61  | 61  | 62   |
|            |            | 3                                              | $b$                                   | 34  | 38  | 41  | 44  | 45  | 47  | 48  | 49  | 49   |
|            |            | 4                                              | 23                                    | 30  | 33  | 36  | 38  | 39  | 41  | 42  | 43  | 43   |
| 4.5        | 3.0        | 1                                              | $b$                                   | $b$ | $b$ | 84  | 92  | 96  | 101 | 106 | 108 | 109  |
|            |            | 2                                              | $b$                                   | 44  | 51  | 55  | 60  | 63  | 66  | 69  | 71  | 72   |
|            |            | 3                                              | $b$                                   | 36  | 42  | 45  | 50  | 52  | 55  | 57  | 58  | 59   |
|            |            | 4                                              | 23                                    | 32  | 37  | 41  | 44  | 47  | 49  | 41  | 52  | 53   |

TABLE 1 Continued

| $\sigma_w$ | $\sigma_b$ | Number of Cores<br>per Sampled<br>Package, $k$ | Number of Packages in Lot, $N$        |    |    |     |     |     |     |     |     |      |
|------------|------------|------------------------------------------------|---------------------------------------|----|----|-----|-----|-----|-----|-----|-----|------|
|            |            |                                                | 25                                    | 50 | 75 | 100 | 150 | 200 | 300 | 500 | 750 | 1000 |
|            |            |                                                | Number of Packages to be Sampled, $n$ |    |    |     |     |     |     |     |     |      |
| 4.5        | 3.5        | 1                                              | b                                     | b  | b  | 85  | 96  | 102 | 108 | 115 | 118 | 120  |
|            |            | 2                                              | b                                     | 45 | 53 | 59  | 66  | 70  | 75  | 79  | 81  | 83   |
|            |            | 3                                              | b                                     | 38 | 45 | 50  | 56  | 60  | 64  | 67  | 69  | 70   |
|            |            | 4                                              | 24                                    | 35 | 41 | 46  | 51  | 54  | 58  | 61  | 63  | 64   |
| 4.5        | 4.0        | 1                                              | b                                     | b  | b  | 87  | 99  | 107 | 116 | 125 | 129 | 132  |
|            |            | 2                                              | b                                     | 46 | 56 | 63  | 72  | 77  | 84  | 90  | 93  | 95   |
|            |            | 3                                              | b                                     | 40 | 49 | 55  | 62  | 67  | 73  | 78  | 81  | 83   |
|            |            | 4                                              | 24                                    | 37 | 45 | 51  | 58  | 62  | 68  | 73  | 75  | 77   |
| 4.5        | 4.5        | 1                                              | b                                     | b  | b  | 88  | 103 | 113 | 124 | 135 | 141 | 145  |
|            |            | 2                                              | b                                     | 46 | 58 | 66  | 77  | 85  | 93  | 101 | 106 | 109  |
|            |            | 3                                              | b                                     | 41 | 51 | 59  | 69  | 75  | 83  | 90  | 94  | 97   |
|            |            | 4                                              | 24                                    | 39 | 48 | 55  | 65  | 71  | 78  | 85  | 89  | 91   |
| 4.5        | 5.0        | 1                                              | b                                     | b  | b  | 89  | 106 | 118 | 132 | 146 | 155 | 159  |
|            |            | 2                                              | b                                     | 47 | 60 | 69  | 83  | 92  | 103 | 114 | 120 | 124  |
|            |            | 3                                              | b                                     | 42 | 54 | 63  | 75  | 83  | 93  | 103 | 109 | 112  |
|            |            | 4                                              | 24                                    | 40 | 51 | 59  | 71  | 79  | 88  | 97  | 103 | 106  |
| 5.0        | 1.0        | 1                                              | b                                     | b  | b  | 97  | 98  | 98  | 99  | 100 | 100 | 100  |
|            |            | 2                                              | b                                     | 49 | 50 | 50  | 51  | 51  | 52  | 52  | 52  | 52   |
|            |            | 3                                              | b                                     | 34 | 35 | 35  | 35  | 36  | 36  | 36  | 36  | 36   |
|            |            | 4                                              | 25                                    | 26 | 27 | 27  | 28  | 28  | 28  | 28  | 28  | 28   |
| 5.0        | 1.5        | 1                                              | b                                     | b  | b  | 97  | 99  | 101 | 102 | 103 | 104 | 104  |
|            |            | 2                                              | b                                     | 49 | 51 | 53  | 54  | 55  | 56  | 56  | 57  | 57   |
|            |            | 3                                              | b                                     | 35 | 37 | 38  | 39  | 39  | 40  | 40  | 51  | 41   |
|            |            | 4                                              | 25                                    | 28 | 30 | 31  | 31  | 32  | 32  | 33  | 33  | 33   |
| 5.0        | 2.0        | 1                                              | b                                     | b  | b  | 97  | 102 | 104 | 106 | 109 | 110 | 110  |
|            |            | 2                                              | b                                     | 49 | 53 | 55  | 58  | 59  | 61  | 62  | 63  | 63   |
|            |            | 3                                              | b                                     | 37 | 40 | 42  | 43  | 44  | 46  | 46  | 47  | 47   |
|            |            | 4                                              | 25                                    | 31 | 33 | 35  | 36  | 37  | 38  | 39  | 39  | 39   |
| 5.0        | 2.5        | 1                                              | b                                     | b  | b  | 97  | 104 | 108 | 112 | 115 | 117 | 118  |
|            |            | 2                                              | b                                     | 49 | 55 | 59  | 63  | 65  | 67  | 69  | 70  | 71   |
|            |            | 3                                              | b                                     | 38 | 43 | 46  | 49  | 51  | 52  | 54  | 55  | 55   |
|            |            | 4                                              | 25                                    | 33 | 37 | 39  | 42  | 43  | 45  | 46  | 47  | 47   |
| 5.0        | 3.0        | 1                                              | b                                     | b  | b  | 98  | 107 | 112 | 118 | 123 | 125 | 127  |
|            |            | 2                                              | b                                     | 49 | 57 | 62  | 68  | 71  | 75  | 78  | 79  | 80   |
|            |            | 3                                              | b                                     | 40 | 46 | 50  | 55  | 57  | 60  | 63  | 64  | 65   |
|            |            | 4                                              | 25                                    | 35 | 41 | 44  | 48  | 50  | 53  | 55  | 57  | 57   |
| 5.0        | 3.5        | 1                                              | b                                     | b  | b  | 98  | 109 | 116 | 124 | 131 | 135 | 137  |
|            |            | 2                                              | b                                     | 49 | 59 | 65  | 73  | 77  | 83  | 87  | 90  | 91   |
|            |            | 3                                              | b                                     | 41 | 49 | 54  | 61  | 65  | 69  | 73  | 75  | 76   |
|            |            | 4                                              | 25                                    | 37 | 44 | 49  | 55  | 58  | 62  | 65  | 67  | 68   |
| 5.0        | 4.0        | 1                                              | b                                     | b  | b  | 98  | 112 | 121 | 131 | 141 | 146 | 149  |
|            |            | 2                                              | b                                     | 50 | 61 | 68  | 78  | 84  | 91  | 98  | 102 | 104  |
|            |            | 3                                              | b                                     | 42 | 52 | 58  | 67  | 72  | 78  | 84  | 87  | 89   |
|            |            | 4                                              | 25                                    | 39 | 47 | 53  | 61  | 66  | 71  | 77  | 80  | 81   |
| 5.0        | 4.5        | 1                                              | b                                     | b  | b  | 98  | 115 | 126 | 139 | 151 | 158 | 162  |
|            |            | 2                                              | b                                     | 50 | 62 | 71  | 83  | 91  | 100 | 109 | 114 | 117  |
|            |            | 3                                              | b                                     | 43 | 54 | 62  | 73  | 80  | 88  | 96  | 100 | 102  |
|            |            | 4                                              | 25                                    | 40 | 50 | 58  | 68  | 74  | 81  | 89  | 93  | 95   |
| 5.0        | 5.0        | 1                                              | b                                     | b  | b  | 98  | 118 | 130 | 146 | 162 | 171 | 176  |
|            |            | 2                                              | b                                     | 50 | 64 | 74  | 88  | 98  | 110 | 121 | 128 | 132  |
|            |            | 3                                              | b                                     | 44 | 57 | 66  | 79  | 87  | 98  | 108 | 114 | 117  |
|            |            | 4                                              | 25                                    | 42 | 53 | 62  | 74  | 82  | 91  | 101 | 107 | 110  |

TABLE 1 Continued

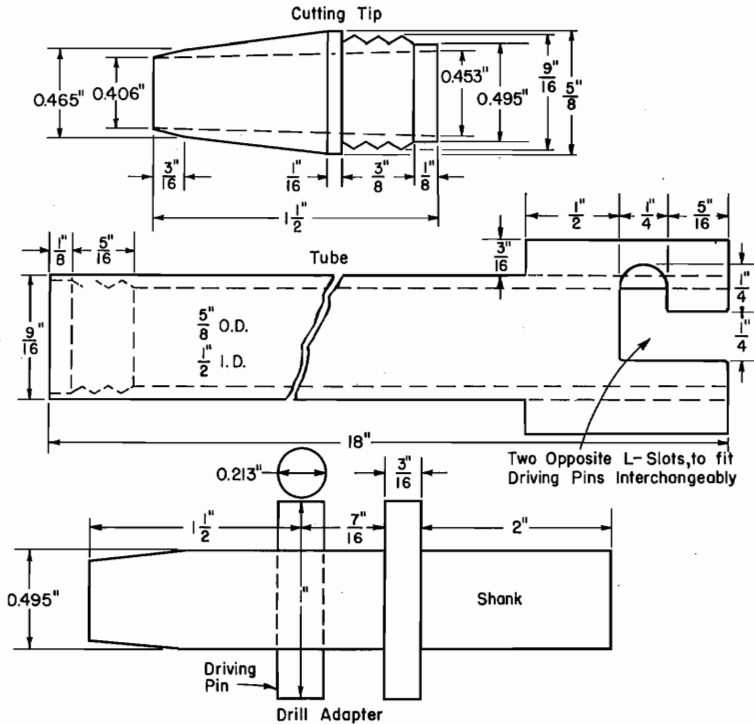
| $\sigma_{IC}$ | $\sigma_b$ | Number of Cores<br>per Sampled<br>Package, $k$ | Number of Packages in Lot, $N$        |    |    |     |     |     |     |     |     |      |
|---------------|------------|------------------------------------------------|---------------------------------------|----|----|-----|-----|-----|-----|-----|-----|------|
|               |            |                                                | 25                                    | 50 | 75 | 100 | 150 | 200 | 300 | 500 | 750 | 1000 |
|               |            |                                                | Number of Packages to be Sampled, $n$ |    |    |     |     |     |     |     |     |      |
| 5.5           | 1.0        | 1                                              | b                                     | b  | b  | b   | 118 | 118 | 119 | 120 | 120 | 120  |
|               |            | 2                                              | b                                     | b  | 59 | 60  | 61  | 61  | 62  | 62  | 62  | 62   |
|               |            | 3                                              | b                                     | 40 | 41 | 42  | 42  | 42  | 43  | 43  | 43  | 43   |
|               |            | 4                                              | b                                     | 31 | 32 | 32  | 33  | 33  | 33  | 33  | 33  | 33   |
|               |            | 5                                              | 24                                    | 26 | 26 | 27  | 27  | 27  | 27  | 27  | 27  | 27   |
|               |            | 6                                              | 21                                    | 22 | 23 | 23  | 23  | 23  | 23  | 24  | 24  | 24   |
| 5.5           | 1.5        | 1                                              | b                                     | b  | b  | b   | 119 | 120 | 122 | 123 | 124 | 124  |
|               |            | 2                                              | b                                     | b  | 60 | 62  | 64  | 64  | 65  | 66  | 66  | 67   |
|               |            | 3                                              | b                                     | 41 | 43 | 44  | 45  | 46  | 47  | 47  | 47  | 47   |
|               |            | 4                                              | b                                     | 33 | 34 | 35  | 36  | 37  | 37  | 38  | 38  | 38   |
|               |            | 5                                              | 24                                    | 28 | 29 | 30  | 31  | 31  | 31  | 32  | 32  | 32   |
|               |            | 6                                              | 21                                    | 24 | 26 | 26  | 27  | 27  | 28  | 28  | 28  | 28   |
| 5.5           | 2.0        | 1                                              | b                                     | b  | b  | b   | 120 | 123 | 126 | 128 | 129 | 130  |
|               |            | 2                                              | b                                     | b  | 61 | 64  | 67  | 69  | 70  | 72  | 72  | 73   |
|               |            | 3                                              | b                                     | 42 | 45 | 47  | 50  | 51  | 52  | 53  | 54  | 54   |
|               |            | 4                                              | b                                     | 34 | 37 | 39  | 41  | 42  | 43  | 44  | 44  | 44   |
|               |            | 5                                              | 24                                    | 30 | 33 | 34  | 36  | 36  | 37  | 38  | 38  | 39   |
|               |            | 6                                              | 22                                    | 27 | 29 | 31  | 32  | 33  | 34  | 34  | 35  | 35   |
| 5.5           | 2.5        | 1                                              | b                                     | b  | b  | b   | 121 | 126 | 130 | 134 | 136 | 137  |
|               |            | 2                                              | b                                     | b  | 63 | 67  | 71  | 74  | 77  | 79  | 80  | 81   |
|               |            | 3                                              | b                                     | 43 | 48 | 51  | 55  | 57  | 59  | 60  | 61  | 62   |
|               |            | 4                                              | b                                     | 36 | 41 | 43  | 46  | 48  | 50  | 51  | 52  | 52   |
|               |            | 5                                              | 25                                    | 32 | 36 | 39  | 41  | 43  | 44  | 46  | 46  | 47   |
|               |            | 6                                              | 23                                    | 30 | 33 | 35  | 38  | 39  | 41  | 42  | 43  | 43   |
| 5.5           | 3.0        | 1                                              | b                                     | b  | b  | b   | 123 | 129 | 136 | 142 | 145 | 146  |
|               |            | 2                                              | b                                     | b  | 64 | 69  | 76  | 80  | 84  | 87  | 89  | 90   |
|               |            | 3                                              | b                                     | 44 | 51 | 55  | 60  | 63  | 66  | 69  | 71  | 71   |
|               |            | 4                                              | b                                     | 38 | 44 | 48  | 52  | 55  | 58  | 60  | 61  | 62   |
|               |            | 5                                              | 25                                    | 35 | 40 | 43  | 47  | 50  | 52  | 55  | 56  | 56   |
|               |            | 6                                              | 23                                    | 32 | 37 | 41  | 44  | 46  | 49  | 51  | 52  | 53   |
| 5.5           | 3.5        | 1                                              | b                                     | b  | b  | b   | 125 | 133 | 142 | 150 | 154 | 156  |
|               |            | 2                                              | b                                     | b  | 65 | 72  | 81  | 86  | 91  | 97  | 99  | 101  |
|               |            | 3                                              | b                                     | 45 | 53 | 59  | 66  | 70  | 75  | 79  | 81  | 82   |
|               |            | 4                                              | b                                     | 40 | 47 | 52  | 58  | 62  | 66  | 70  | 72  | 73   |
|               |            | 5                                              | 25                                    | 37 | 44 | 48  | 54  | 57  | 61  | 65  | 67  | 68   |
|               |            | 6                                              | 24                                    | 35 | 41 | 46  | 51  | 54  | 58  | 61  | 63  | 64   |
| 5.5           | 4.0        | 1                                              | b                                     | b  | b  | b   | 127 | 136 | 148 | 159 | 165 | 168  |
|               |            | 2                                              | b                                     | b  | 66 | 75  | 85  | 92  | 100 | 107 | 111 | 113  |
|               |            | 3                                              | b                                     | 45 | 56 | 63  | 72  | 77  | 84  | 90  | 93  | 95   |
|               |            | 4                                              | b                                     | 41 | 50 | 57  | 65  | 70  | 76  | 81  | 84  | 86   |
|               |            | 5                                              | 25                                    | 38 | 47 | 53  | 61  | 65  | 71  | 76  | 79  | 80   |
|               |            | 6                                              | 24                                    | 37 | 45 | 51  | 58  | 62  | 68  | 72  | 75  | 77   |
| 5.5           | 4.5        | 1                                              | b                                     | b  | b  | b   | 128 | 140 | 155 | 168 | 176 | 180  |
|               |            | 2                                              | b                                     | b  | 67 | 77  | 90  | 98  | 108 | 118 | 124 | 127  |
|               |            | 3                                              | b                                     | 46 | 58 | 66  | 77  | 84  | 93  | 101 | 106 | 109  |
|               |            | 4                                              | b                                     | 42 | 53 | 61  | 71  | 77  | 85  | 93  | 97  | 100  |
|               |            | 5                                              | 25                                    | 40 | 50 | 57  | 67  | 73  | 81  | 88  | 92  | 94   |
|               |            | 6                                              | 24                                    | 39 | 48 | 55  | 64  | 70  | 78  | 85  | 89  | 91   |
| 5.5           | 5.0        | 1                                              | b                                     | b  | b  | b   | 130 | 144 | 161 | 179 | 189 | 194  |
|               |            | 2                                              | b                                     | b  | 68 | 79  | 94  | 105 | 117 | 130 | 137 | 141  |
|               |            | 3                                              | b                                     | 47 | 60 | 69  | 83  | 92  | 103 | 114 | 120 | 123  |
|               |            | 4                                              | b                                     | 43 | 55 | 64  | 77  | 85  | 95  | 105 | 111 | 115  |
|               |            | 5                                              | 25                                    | 41 | 53 | 61  | 73  | 81  | 91  | 101 | 106 | 109  |
|               |            | 6                                              | 24                                    | 40 | 51 | 59  | 71  | 78  | 88  | 97  | 103 | 106  |

TABLE 1 Concluded

| $\sigma_w$ | $\sigma_b$ | Number of Cores<br>per Sampled<br>Package, $k$ | Number of Packages in Lot, $N$        |          |          |          |     |     |     |     |     |      |
|------------|------------|------------------------------------------------|---------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|
|            |            |                                                | 25                                    | 50       | 75       | 100      | 150 | 200 | 300 | 500 | 750 | 1000 |
|            |            |                                                | Number of Packages to be Sampled, $n$ |          |          |          |     |     |     |     |     |      |
| 6.0        | 1.0        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 139 | 140 | 141 | 142 | 142 | 142  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 70       | 71       | 72  | 72  | 73  | 73  | 73  | 73   |
|            |            | 3                                              | <i>b</i>                              | 47       | 48       | 49       | 49  | 49  | 50  | 50  | 50  | 50   |
|            |            | 4                                              | <i>b</i>                              | 36       | 37       | 37       | 38  | 38  | 38  | 39  | 39  | 39   |
|            |            | 5                                              | <i>b</i>                              | 30       | 30       | 31       | 31  | 31  | 32  | 32  | 32  | 32   |
|            |            | 6                                              | 24                                    | 25       | 26       | 26       | 27  | 27  | 27  | 27  | 27  | 27   |
| 6.0        | 1.5        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 139 | 141 | 143 | 145 | 146 | 146  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 70       | 72       | 74  | 75  | 76  | 77  | 77  | 78   |
|            |            | 3                                              | <i>b</i>                              | 47       | 50       | 51       | 52  | 53  | 54  | 54  | 55  | 55   |
|            |            | 4                                              | <i>b</i>                              | 37       | 39       | 40       | 41  | 42  | 43  | 43  | 43  | 43   |
|            |            | 5                                              | <i>b</i>                              | 31       | 33       | 34       | 35  | 35  | 36  | 36  | 36  | 36   |
|            |            | 6                                              | 24                                    | 28       | 29       | 30       | 30  | 31  | 31  | 32  | 32  | 32   |
| 6.0        | 2.0        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 140 | 143 | 147 | 150 | 151 | 152  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 71       | 74       | 77  | 79  | 81  | 82  | 83  | 84   |
|            |            | 3                                              | <i>b</i>                              | 48       | 52       | 54       | 56  | 58  | 59  | 60  | 61  | 61   |
|            |            | 4                                              | <i>b</i>                              | 39       | 42       | 44       | 46  | 47  | 48  | 49  | 49  | 50   |
|            |            | 5                                              | <i>b</i>                              | 33       | 36       | 38       | 40  | 40  | 41  | 42  | 43  | 43   |
|            |            | 6                                              | 24                                    | 30       | 32       | 34       | 35  | 36  | 37  | 38  | 38  | 38   |
| 6.0        | 2.5        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 140 | 145 | 151 | 155 | 158 | 159  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 71       | 76       | 81  | 84  | 87  | 89  | 91  | 91   |
|            |            | 3                                              | <i>b</i>                              | 48       | 54       | 57       | 61  | 63  | 65  | 67  | 68  | 69   |
|            |            | 4                                              | <i>b</i>                              | 40       | 45       | 48       | 51  | 53  | 55  | 56  | 57  | 58   |
|            |            | 5                                              | <i>b</i>                              | 35       | 40       | 42       | 45  | 47  | 48  | 50  | 51  | 51   |
|            |            | 6                                              | 25                                    | 32       | 36       | 38       | 41  | 43  | 44  | 45  | 46  | 46   |
| 6.0        | 3.0        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 141 | 148 | 156 | 162 | 166 | 168  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 71       | 78       | 85  | 89  | 94  | 98  | 100 | 101  |
|            |            | 3                                              | <i>b</i>                              | 48       | 56       | 60       | 66  | 69  | 73  | 76  | 78  | 78   |
|            |            | 4                                              | <i>b</i>                              | 41       | 48       | 52       | 57  | 59  | 63  | 65  | 67  | 67   |
|            |            | 5                                              | <i>b</i>                              | 37       | 43       | 47       | 51  | 54  | 56  | 59  | 60  | 61   |
|            |            | 6                                              | 25                                    | 35       | 40       | 43       | 47  | 50  | 52  | 54  | 56  | 56   |
| 6.0        | 3.5        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 142 | 151 | 161 | 170 | 175 | 178  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 72       | 80       | 89  | 95  | 101 | 107 | 110 | 111  |
|            |            | 3                                              | <i>b</i>                              | 48       | 58       | 64       | 71  | 76  | 81  | 86  | 88  | 89   |
|            |            | 4                                              | <i>b</i>                              | 43       | 51       | 56       | 63  | 67  | 71  | 75  | 77  | 78   |
|            |            | 5                                              | <i>b</i>                              | 39       | 46       | 51       | 57  | 61  | 65  | 69  | 71  | 72   |
|            |            | 6                                              | 25                                    | 37       | 44       | 48       | 54  | 57  | 61  | 65  | 66  | 767  |
| 6.0        | 4.0        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 142 | 153 | 166 | 178 | 185 | 189  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 72       | 81       | 93  | 100 | 109 | 117 | 121 | 124  |
|            |            | 3                                              | <i>b</i>                              | 49       | 60       | 67       | 77  | 83  | 90  | 96  | 100 | 102  |
|            |            | 4                                              | <i>b</i>                              | 42       | 53       | 60       | 69  | 74  | 80  | 86  | 89  | 91   |
|            |            | 5                                              | <i>b</i>                              | 40       | 49       | 56       | 64  | 69  | 74  | 80  | 83  | 84   |
|            |            | 6                                              | 25                                    | 38       | 47       | 53       | 60  | 65  | 71  | 76  | 79  | 80   |
| 6.0        | 4.5        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 143 | 156 | 172 | 187 | 196 | 201  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 73       | 83       | 97  | 106 | 117 | 128 | 134 | 137  |
|            |            | 3                                              | <i>b</i>                              | 49       | 61       | 70       | 82  | 90  | 99  | 108 | 113 | 115  |
|            |            | 4                                              | <i>b</i>                              | 44       | 56       | 64       | 74  | 81  | 90  | 98  | 102 | 105  |
|            |            | 5                                              | <i>b</i>                              | 42       | 52       | 60       | 70  | 76  | 84  | 92  | 96  | 98   |
|            |            | 6                                              | 25                                    | 40       | 50       | 57       | 67  | 73  | 81  | 88  | 92  | 94   |
| 6.0        | 5.0        | 1                                              | <i>b</i>                              | <i>b</i> | <i>b</i> | <i>b</i> | 143 | 159 | 178 | 197 | 208 | 214  |
|            |            | 2                                              | <i>b</i>                              | <i>b</i> | 73       | 85       | 101 | 112 | 126 | 139 | 147 | 151  |
|            |            | 3                                              | <i>b</i>                              | 49       | 63       | 73       | 87  | 96  | 108 | 120 | 126 | 130  |
|            |            | 4                                              | <i>b</i>                              | 44       | 58       | 67       | 80  | 89  | 99  | 110 | 116 | 120  |
|            |            | 5                                              | <i>b</i>                              | 43       | 55       | 64       | 76  | 84  | 94  | 104 | 110 | 113  |
|            |            | 6                                              | 25                                    | 41       | 53       | 61       | 73  | 81  | 9   | 100 | 106 | 109  |

<sup>a</sup> For a probability level of 95 percent, the value of  $t$  Eq 1 is 1.96.

<sup>b</sup> The specified precision cannot be obtained with this number of cores,  $k$ , per package.



(Metric equivalents may be calculated by multiplying inches by 25.4 to obtain equivalent dimensions in millimeters.)

FIG. 1 Small Diameter Wool Sampling Tool (Bureau of Customs).

## APPENDIX

### A1. CLASSIFICATION OF WOOLS FOR SAMPLING PURPOSES

A1.1 Committee studies have shown that the values for  $\sigma_w$  and  $\sigma_b$  listed in Table A1 are good estimates of the average values for lots of several types of packaged wool as they appeared in the commerce of the United States of America early in 1964, provided the packages comprising the lot conformed to the following conditions:

A1.1.1 Each package was uniformly and randomly packed.

A1.1.2 All packages were undamaged (Note A1), of the same kind (bales or bags), and of approximately the same dimensions and weight, within usual commercial limits.

A1.1.3 All packages contained the same kind of

wool or hair (sheep, goat, camel, alpaca, etc.), from the same geographic area, of the same general character (apparel or carpet type, fleece, matchings, crutchings, etc.), and in the same general condition (grease, scoured, washed, pulled, etc.).

NOTE A1—The data given in Table A1 would not be applicable to lots containing packages materially damaged by water, oil, or other agent unless these packages were first removed from the lot for separate evaluation. Normally soiled or torn coverings of themselves do not indicate material damage for sampling purposes.

TABLE A1 Estimates of  $\sigma_w$  and  $\sigma_b$  for Percentage Clean Wool Content of Lots<sup>a</sup> of Packaged Wool of Several Types

| Classification                    | $\sigma_w$         | $\sigma_b$            | Classification                   | $\sigma_w$         | $\sigma_b$            |
|-----------------------------------|--------------------|-----------------------|----------------------------------|--------------------|-----------------------|
| <b>A. Apparel Wool, Foreign:</b>  |                    |                       | <b>C. Carpet Wool:</b>           |                    |                       |
| (1) Greasy, not burry:            |                    |                       | (1) Washed or greasy, not burry: |                    |                       |
| Argentina                         | 2.5                | 2.5                   | Aleppo                           | 3.0                | 2.5                   |
| Australia                         | 1.5                | 4.0                   | B.A.                             | 3.5                | 2.5                   |
| Brazil                            | 2.5                | 2.5                   | Blackface                        | 4.0                | 3.5                   |
| Canada                            | 4.5                | 2.0                   | India (other than Vicanere):     |                    |                       |
| Chile                             | 2.0                | 5.0                   | White                            | 2.5                | 1.5                   |
| Peru, wool                        | 2.5                | 2.5                   | Colored                          | 3.5                | 3.0                   |
| Peru, alpaca                      | 3.0                | 1.5                   | Iran                             | 3.5                | 3.5                   |
| New Zealand                       | 1.5                | 4.0                   | Iraq                             | 3.5                | 2.0                   |
| South Africa                      | 1.5                | 4.0                   | New Zealand crutchings           | 3.5                | 5.0                   |
| Uruguay                           | 3.0                | 1.5                   | Pakistan                         | 2.0                | 5.0                   |
| (2) Pulled, not burry:            |                    |                       | Vicanere                         | 3.0                | 2.5                   |
| Slight lime, all types            | 1.5                | 1.5                   | (2) Washed or greasy, burry:     |                    |                       |
| Heavy lime, all types             | 2.5                | 2.5                   | 5 to 10 percent burr,            | increase           | corre-                |
| (3) Scoured, not burry:           |                    |                       | scoured basis                    | sponding "not bur- | ry" $\sigma_w$ by 1.0 |
| Well scoured, all types           | 1.0                | 1.0                   | Over 10 percent burr,            | increase           | corre-                |
| Poorly scoured, all types         | 1.5                | 1.5                   | scoured basis                    | sponding "not bur- | ry" $\sigma_w$ by 2.0 |
| (4) Burry:                        |                    |                       | (3) Pulled or colored            | same as washed or  | greasy, burry, 5 to   |
| 5 to 10 percent burr,             | increase           | corre-                |                                  | 10 percent         |                       |
| scoured basis                     | sponding "not bur- | ry" $\sigma_w$ by 1.0 | (4) Scoured, not burry:          |                    |                       |
| Over 10 percent burr,             | increase           | corre-                | Well scoured, all types          | 1.0                | 1.0                   |
| scoured basis                     | sponding "not bur- | ry" $\sigma_w$ by 2.0 | Poorly scoured, all types        | 1.5                | 1.5                   |
| <b>B. Apparel Wool, Domestic:</b> |                    |                       | (5) Scoured, burry:              |                    |                       |
| (1) Original bags, ungraded       | 4.5                | 2.0                   | 5 to 10 percent burr             | 2.5                | 1.5                   |
| (2) Territory wool, graded        | 4.5                | 2.0                   | Over 10 percent burr             | 3.5                | 1.5                   |
| (3) Fleece wools, graded          | 5.0                | 2.0                   |                                  |                    |                       |

<sup>a</sup> For restrictions on the packages that may be included in a lot to which the estimates apply, see A1.1.1, A1.1.2, and A1.1.3.

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